MEMO FOR RECORD
FROM: Andrew Tuthill
DATE: 17 Dec. 2003
SUBJECT: Freezeup Ice Jam at Hardwick,

On 16 Dec. 2003, Andy Tuthill of CRREL inspected freezeup ice jam on the Lamoille River at Hardwick, VT, in response to a call from Dan Hill, Hardwick Town Manager (802-472-6120). The ice jam formed between Hardwick Lake and Cottage Street Bridge on about Dec. 5, backing up the storm drains and flooding one lane of Route 15 (Fig. 1). A thaw with rain on Dec. 11 broke up the ice above town, adding it to the frazil ice jam in the village. Jackson Dam, a small hydro project at the outlet of Hardwick Lake usually opens a gate to lower their pool prior to freezeup, but this year, the gate was not opened in time, resulting in a freezeup lake level about 5 ft higher than normal. Other factors contributing to frazil ice congestion of the Lamoille at Hardwick were above-average river discharges (Fig. 2) and below-average air temperatures for the month of December in northern New England. (Figs.3 and 4).

The town responded by digging a 0.6-mile-long channel through the ice jam using two large excavators. The channel extends from the Cottage St. Bridge to a point about 500 feet downstream of the railroad bridge. Below the Cottage St. Bridge, the channel is about 10 ft wide and running well at about 3-4 ft/s (Fig. 5). The ice removed from the channel has been cleared from the right hand floodplain to provide additional flow relief in anticipation of higher discharges and breakup. Between the snowmobile bridge and the railroad bridge the river is deeper and wider making it more difficult to excavate a well-defined channel to convey the frazil (Fig. 6). Dan Hill said that the ice congestion in this section is also aggravated by frazil flowing in from Cooper Brook, just upstream. Downstream of the railroad bridge, water velocity is higher again, and the frazil was moving well until it reached the backwater of Jackson Dam (Fig. 7).

From the Cottage St. Bridge for at least 3 miles upstream, the Lamoille was open and flows were up (about 500 cfs). Fig 2 shows discharge downstream at Johnson, VT for the November- December period to be about 2 and 4 times the long-term average. The night of Dec. 15-16 had near 0ºF air temperatures and on the morning of the 16th, the water surface was about 20 % covered in moving frazil slush about 1-2 inches thick (Fig. 8).

Although the town Hardwick has responded as well as possible to this event, they are financially unable to continue their flood fighting effort. At an hourly rate of $100 for a large excavator, they have now spent about $20,000 to maintain the free flowing channel through the ice jam. The above average discharge and cold air temperatures, combined with two thaw and rain events, have delayed ice formation in the rapids reach above town, and this lack of an insulating cover has resulted in high frazil ice production. The best hope is a return to more normal river discharges and air temperatures. For at least the next four days, temperatures will be mild, which should help erode the jam and improve flow conveyance through the ice jam reach. The eventual formation of an upstream ice cover will further improve the situation by reducing the production of frazil ice supplying the ice jam in the village.

Respectfully Submitted,

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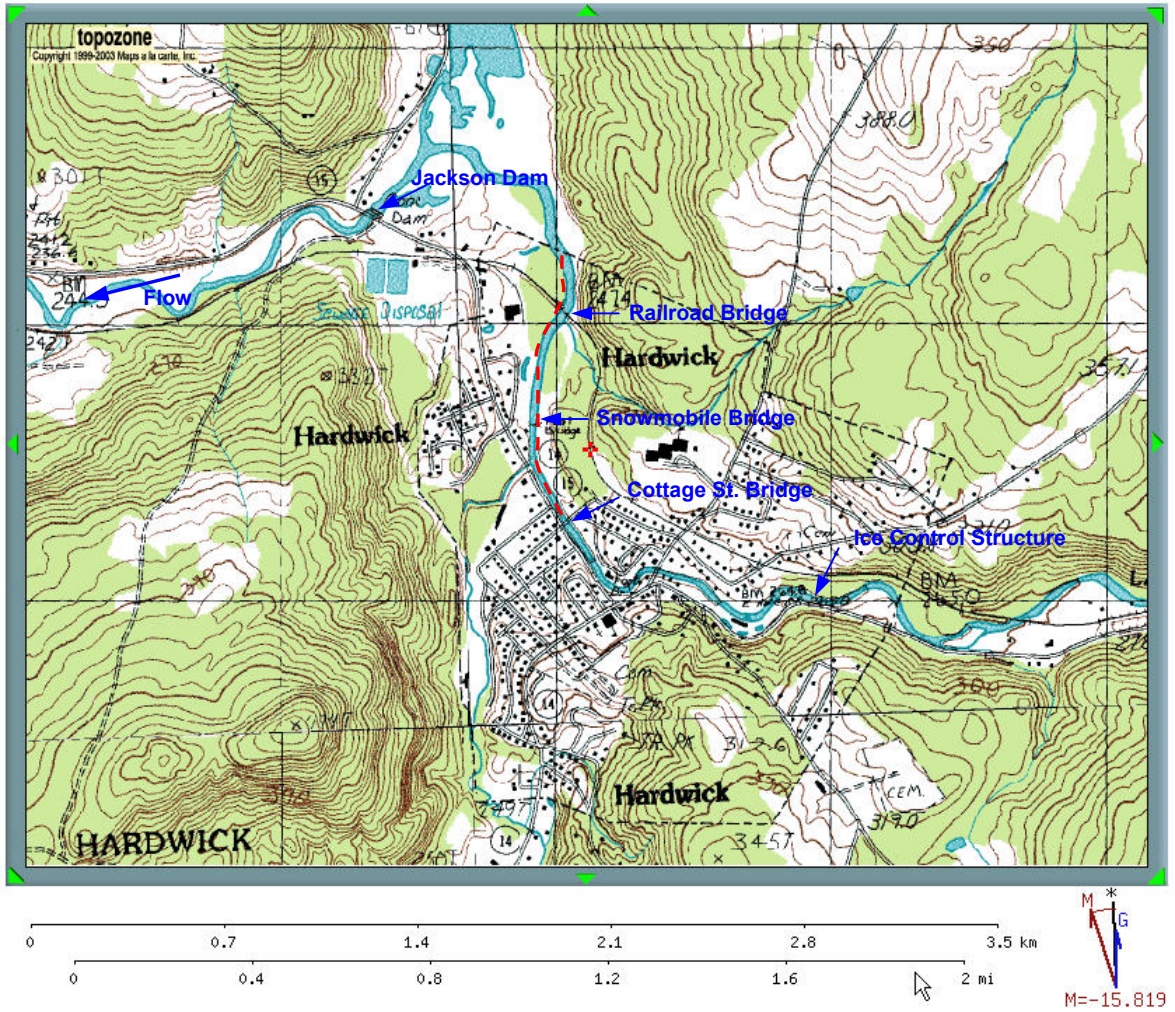


Fig. 1. Map of Hardwick, VT. Red dashed line shows the extent of the excavated channel through ice jam.

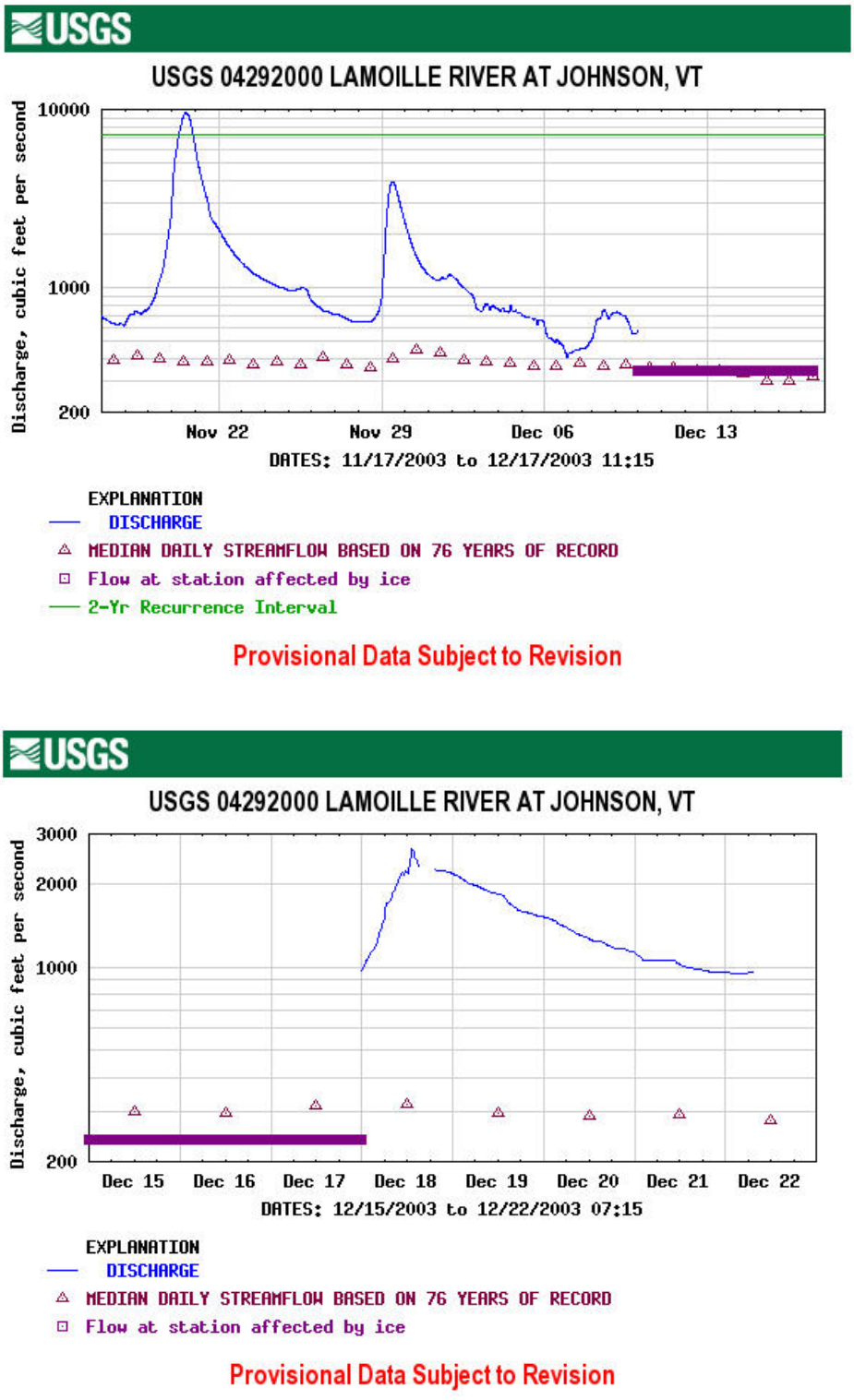
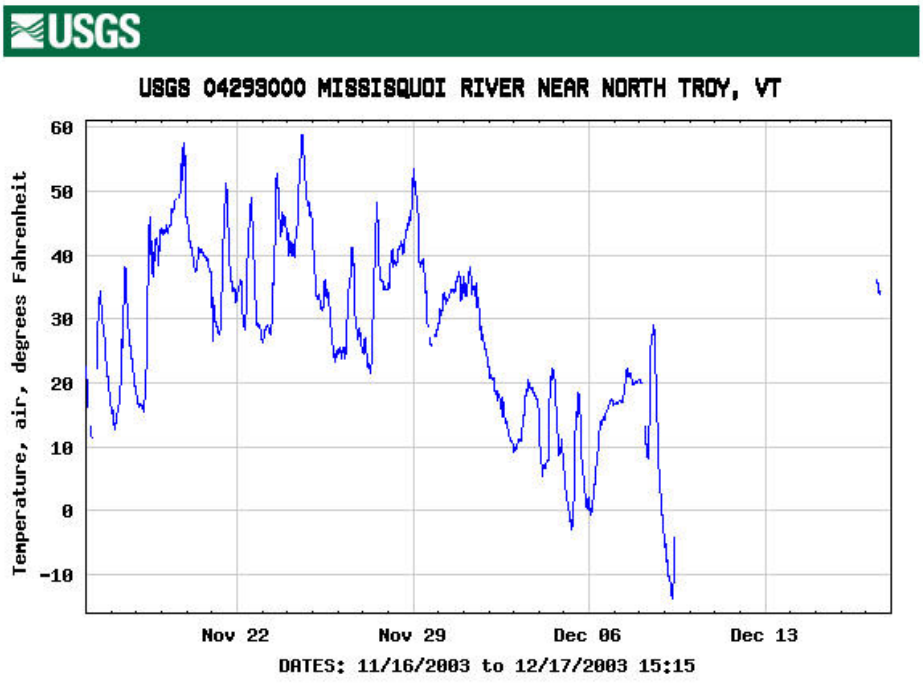


Fig. 2. Recent Lamoille River discharge at Johnson, VT, compared to long term averages.



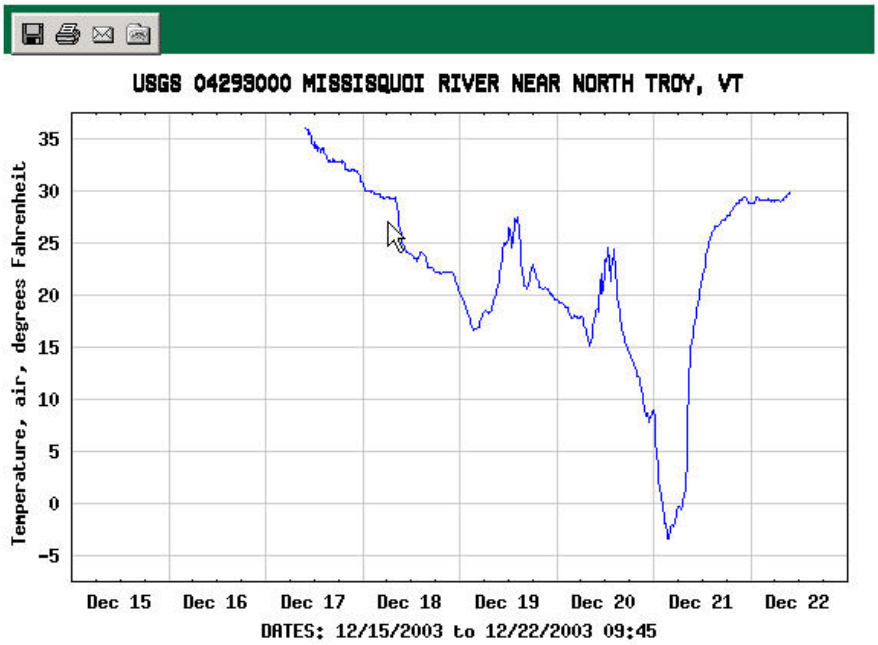


Fig. 3. Recent air temperatures at N. Troy, VT

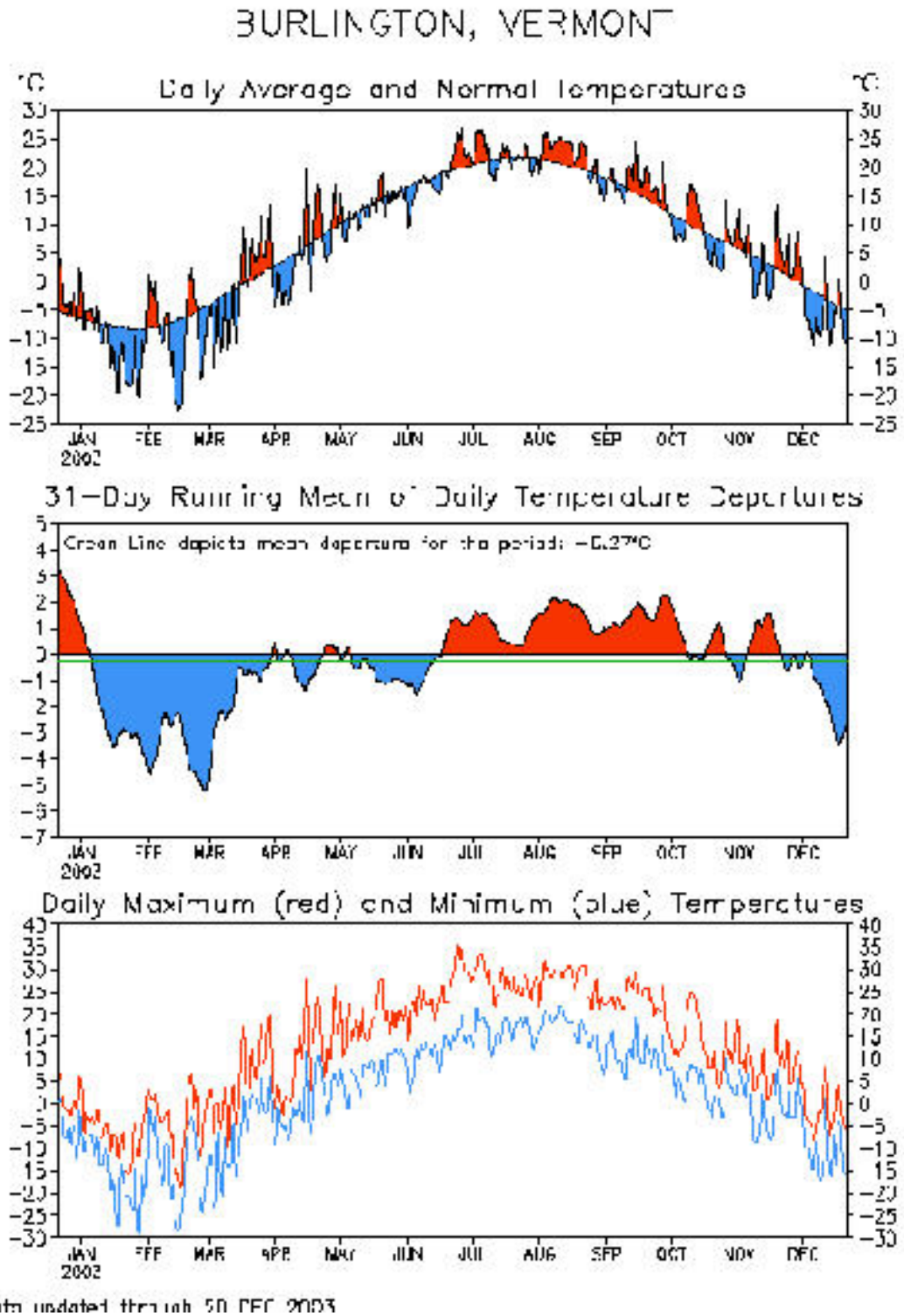


Fig. 4. Recent air temperatures compared to long-term averages for Burlington, VT. Note that December 2003 air temperatures are well below average.

Fig. 5. Free flowing channel excavated through freezeup ice jam below Cottage St. Bridge at Hardwick, VT. The righthand floodplain has also been cleared of ice debris.

Fig. 6. Excavators removing ice downstream of the snowmobile bridge.

Fig. 7. Downstream end of the excavated channel, near the backwater of Hardwick Lake.

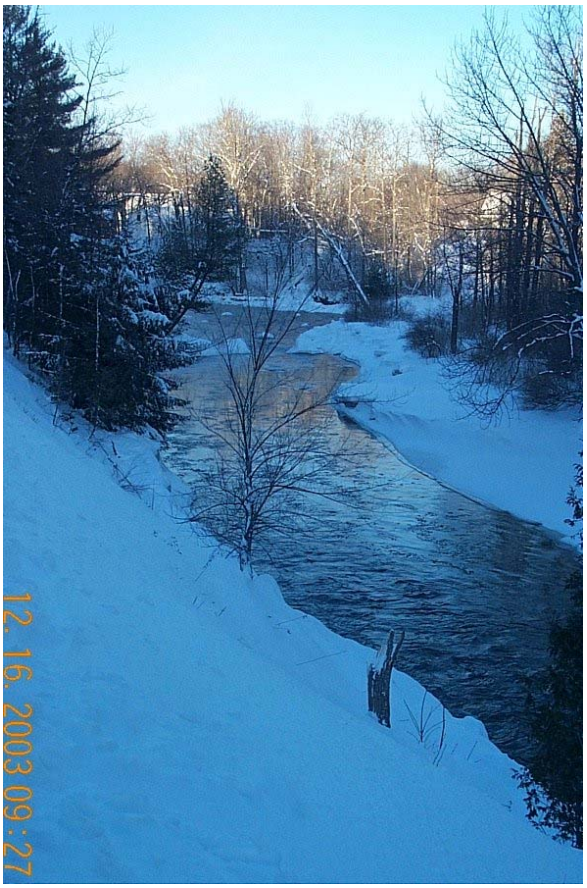


Fig. 8. Lamoille River upstream of Hardwick Village conveying frazil ice. The ice control blocks are visible.